Anses Scientific and Doctoral Days

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Influence of the agricultural landscape structure on the spread of a disease: the case of citrus greening in Réunion island

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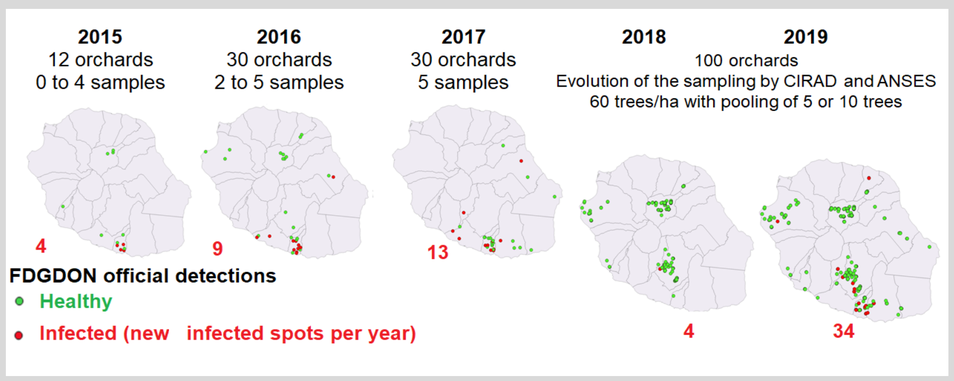
CITRUS GREENING RE-EMERGES IN RÉUNION

Citrus greening (or Huanglongbing or HLB), caused by the bacteria Candidatus Liberibacter spp. and spread by the psyllid vectors, is reemerging is Réunion island since 2012. As a category 2 pest, it is under epidemiological surveillance by DAAF* and FDGDON*, with the support of an advising committee composed by ANSES, CIRAD, Armeflhor, and other stakeholders. Infected trees, detected by molecular analysis (PCR), are to be uprooted.

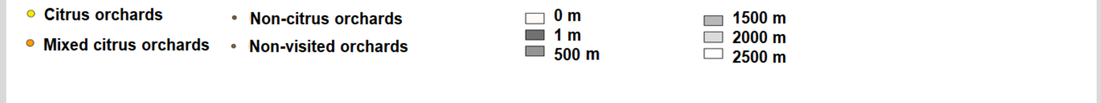


General purpose of the project: Provide guidelines to optimize surveillance of disease propagation.

Scientific objective: Test for the existence of a relationship between landscape structure and disease.

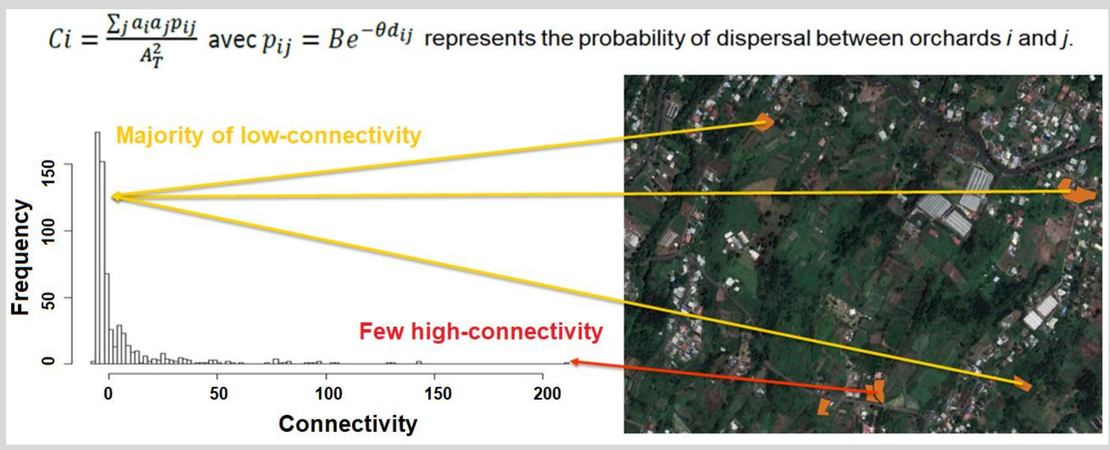
CARTOGRAPHY OF CITRUS ORCHARDS

We postulate that the landscape structure contains information on where the disease is expected to be found. To test this assumption, we first need the full distribution of citrus orchards in the Réunion landscape. For this purpose, an important effort of cartography of citrus orchards has been made and is still continuing nowadays.



ANALYSING LANDSCAPE STRUCTURE

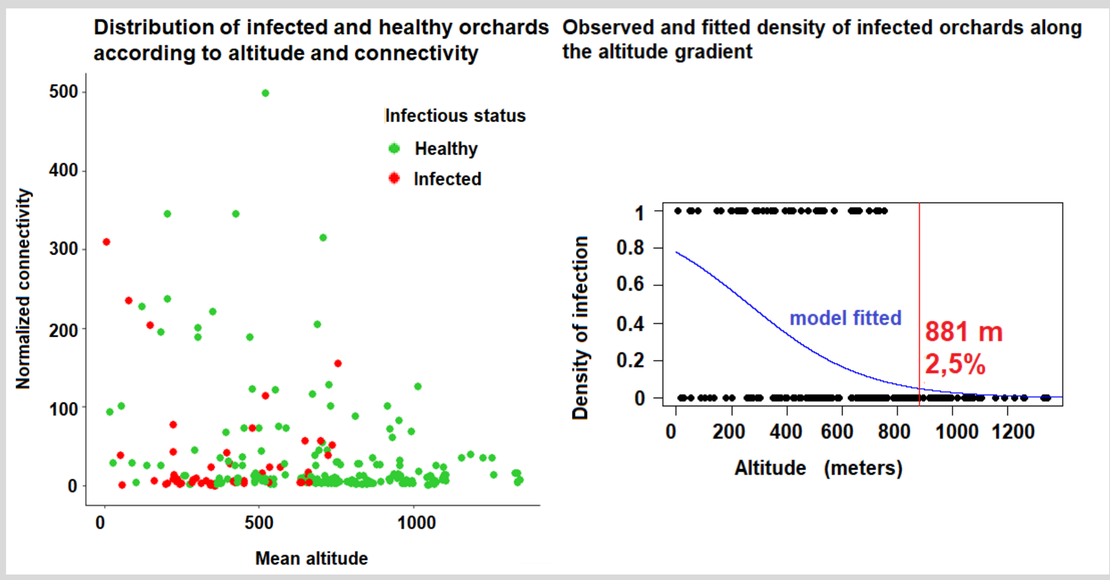
Patch connectivity, say *Ci,* computed from patch areas and inter-patch distances, was initially a tool of landscape ecology but can be applied to epidemiology as an indicator of dispersal capacity:



LANDSCAPE CONNECTIVITY AS A RISK PREDICTOR

A generalized linear model was used to test the correlation between orchard connectivity (*Ci*), and the presence / absence records of the disease, accounting for possible altitude gradients.

We find a significant relationship between orchard connectivity and the presence of the disease (*p-value* = 0.021).



Our model highlights a strong correlation between presence of the disease and altitude (*p-value* = 2.02^{e}-10).
The propagation of the disease does not exceed a threshold altitude (724 meters (observed), 881(predicted) roughly corresponding to the known niche limits of psyllid vectors).

TO GO FURTHER

- We shown that highly connected orchards are more frequently infected by citrus greening than low-connectivity orchards.
- High-connectivity citrus orchards could thus be proposed as priority targets of surveillance.
- Before generalization of the method, a simulation study is needed to evaluate the robustness of the result to:
  - disease introduction point
  - the existence of physical barriers in the landscape that affect the movement abilities of the disease psyllid vectors.

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